

**IN THE CLAIMS:**

1. (previously presented) A copolymer comprising an isoolefin and a multiolefin, the copolymer being substantially free of long chain branching; wherein the copolymer has a  $g'_{vis,avg}$  greater than or equal to 0.978 as determined by triple detection SEC.
2. (previously presented) The copolymer of claim 1, wherein the multiolefin is a conjugated diene.
3. (currently amended) The copolymer of claim 1, wherein the multiolefin content is ~~from~~ greater than 0.5 wt%.
4. – 6. (cancelled)
7. (previously presented) A copolymer comprising isobutylene and isoprene, the copolymer being substantially free of long chain branching; wherein the copolymer has a  $g'_{vis,avg}$  greater than or equal to 0.978 as determined by triple detection SEC.
8. (currently amended) The copolymer of claim 7, wherein the isoprene content is ~~from~~ greater than 0.5 wt%.
9. – 11. (cancelled)
12. (previously presented) A copolymer produced by the process comprising contacting an isoolefin, a multiolefin, one or more Lewis acid(s), one or more initiator(s), and a diluent comprising one or more hydrofluorocarbon(s) (HFC's); wherein the copolymer is substantially free of long chain branching and wherein the copolymer has a  $g'_{vis,avg}$  greater than or equal to 0.978 as determined by triple detection SEC.
13. (previously presented) The copolymer of claim 12, wherein the multiolefin is a conjugated diene.

14. (currently amended) The copolymer of claim 12, wherein the multiolefin content is ~~from~~ greater than 0.5 wt%.
15. - 17. (cancelled)
18. (previously presented) The copolymer of claim 12, wherein one or more hydrofluorocarbon(s) is represented by the formula:  $C_xH_yF_z$  wherein x is an integer from 1 to 40 and y and z are integers of one or more.
19. (previously presented) The copolymer of claim 18, wherein x is from 1 to 10.
20. - 21. (cancelled)
22. (previously presented) The copolymer of claim 12, wherein the one or more hydrofluorocarbon(s) is independently selected from the group consisting of fluoromethane; difluoromethane; trifluoromethane; fluoroethane; 1,1-difluoroethane; 1,2-difluoroethane; 1,1,1-trifluoroethane; 1,1,2-trifluoroethane; 1,1,1,2-tetrafluoroethane; 1,1,2,2-tetrafluoroethane; 1,1,1,2,2-pentafluoroethane; 1-fluoropropane; 2-fluoropropane; 1,1-difluoropropane; 1,2-difluoropropane; 1,3-difluoropropane; 2,2-difluoropropane; 1,1,1-trifluoropropane; 1,1,2-trifluoropropane; 1,1,3-trifluoropropane; 1,2,2-trifluoropropane; 1,2,3-trifluoropropane; 1,1,1,2-tetrafluoropropane; 1,1,1,3-tetrafluoropropane; 1,1,2,2-tetrafluoropropane; 1,1,2,3-tetrafluoropropane; 1,1,3,3-tetrafluoropropane; 1,2,2,3-tetrafluoropropane; 1,1,1,2,2-pentafluoropropane; 1,1,1,2,3-pentafluoropropane; 1,1,1,3,3-pentafluoropropane; 1,1,2,2,3-pentafluoropropane; 1,1,2,3,3-pentafluoropropane; 1,1,1,2,2,3-hexafluoropropane; 1,1,1,2,3,3-hexafluoropropane; 1,1,1,3,3,3-hexafluoropropane; 1,1,1,2,2,3,3-heptafluoropropane; 1,1,1,2,3,3,3-heptafluoropropane; 1-fluorobutane; 2-fluorobutane; 1,1-difluorobutane; 1,2-difluorobutane; 1,3-difluorobutane; 1,4-difluorobutane; 2,2-difluorobutane; 2,3-difluorobutane; 1,1,1-trifluorobutane; 1,1,2-trifluorobutane; 1,1,3-trifluorobutane; 1,1,4-trifluorobutane; 1,2,2-trifluorobutane; 1,2,3-trifluorobutane; 1,3,3-trifluorobutane; 2,2,3-trifluorobutane; 1,1,1,2-tetrafluorobutane; 1,1,1,3-tetrafluorobutane; 1,1,1,4-tetrafluorobutane; 1,1,2,2-tetrafluorobutane; 1,1,2,3-tetrafluorobutane; 1,1,2,4-tetrafluorobutane; 1,1,3,3-

tetrafluorobutane; 1,1,3,4-tetrafluorobutane; 1,1,4,4-tetrafluorobutane; 1,2,2,3-tetrafluorobutane; 1,2,2,4-tetrafluorobutane; 1,2,3,3-tetrafluorobutane; 1,2,3,4-tetrafluorobutane; 2,2,3,3-tetrafluorobutane; 1,1,1,2,2-pentafluorobutane; 1,1,1,2,3-pentafluorobutane; 1,1,1,2,4-pentafluorobutane; 1,1,1,3,3-pentafluorobutane; 1,1,1,3,4-pentafluorobutane; 1,1,1,4,4-pentafluorobutane; 1,1,2,2,3-pentafluorobutane; 1,1,2,2,4-pentafluorobutane; 1,1,2,3,3-pentafluorobutane; 1,1,2,4,4-pentafluorobutane; 1,1,3,3,4-pentafluorobutane; 1,2,2,3,3-pentafluorobutane; 1,2,2,3,4-pentafluorobutane; 1,1,1,2,2,3-hexafluorobutane; 1,1,1,2,2,4-hexafluorobutane; 1,1,1,2,3,3-hexafluorobutane; 1,1,1,2,3,4-hexafluorobutane; 1,1,1,2,4,4-hexafluorobutane; 1,1,1,3,3,4-hexafluorobutane; 1,1,1,3,4,4-hexafluorobutane; 1,1,1,4,4,4-hexafluorobutane; 1,1,2,2,3,3-hexafluorobutane; 1,1,2,2,3,4-hexafluorobutane; 1,1,2,2,4,4-hexafluorobutane; 1,1,2,3,3,4-hexafluorobutane; 1,1,2,3,4,4-hexafluorobutane; 1,2,2,3,3,4-hexafluorobutane; 1,1,1,2,2,3,3-heptafluorobutane; 1,1,1,2,2,4,4-heptafluorobutane; 1,1,1,2,2,3,4-heptafluorobutane; 1,1,1,2,3,3,4-heptafluorobutane; 1,1,1,2,3,4,4-heptafluorobutane; 1,1,1,2,4,4,4-heptafluorobutane; 1,1,1,3,3,4,4-heptafluorobutane; 1,1,1,2,2,3,3,4-octafluorobutane; 1,1,1,2,2,3,4,4-octafluorobutane; 1,1,1,2,3,3,4,4-octafluorobutane; 1,1,1,2,2,4,4,4-octafluorobutane; 1,1,1,2,3,4,4,4-octafluorobutane; 1,1,1,2,2,3,3,4,4-nonafluorobutane; 1,1,1,2,2,3,4,4,4-nonafluorobutane; 1-fluoro-2-methylpropane; 1,1-difluoro-2-methylpropane; 1,3-difluoro-2-methylpropane; 1,1,1-trifluoro-2-methylpropane; 1,1,3-trifluoro-2-methylpropane; 1,3-difluoro-2-(fluoromethyl)propane; 1,1,1,3-tetrafluoro-2-methylpropane; 1,1,3,3-tetrafluoro-2-methylpropane; 1,1,3-trifluoro-2-(fluoromethyl)propane; 1,1,1,3,3-pentafluoro-2-methylpropane; 1,1,3,3-tetrafluoro-2-(fluoromethyl)propane; 1,1,1,3-tetrafluoro-2-(fluoromethyl)propane; fluorocyclobutane; 1,1-difluorocyclobutane; 1,2-difluorocyclobutane; 1,3-difluorocyclobutane; 1,1,2-trifluorocyclobutane; 1,1,3-trifluorocyclobutane; 1,2,3-trifluorocyclobutane; 1,1,2,2-tetrafluorocyclobutane; 1,1,3,3-tetrafluorocyclobutane; 1,1,2,2,3-pentafluorocyclobutane; 1,1,2,3,3-pentafluorocyclobutane; 1,1,2,2,3,3-hexafluorocyclobutane; 1,1,2,2,3,4-hexafluorocyclobutane; 1,1,2,3,3,4-hexafluorocyclobutane; 1,1,2,2,3,3,4-heptafluorocyclobutane; vinyl fluoride; 1,1-difluoroethene; 1,2-difluoroethene; 1,1,2-trifluoroethene; 1-fluoropropene, 1,1-difluoropropene; 1,2-difluoropropene; 1,3-difluoropropene; 2,3-difluoropropene; 3,3-difluoropropene; 1,1,2-trifluoropropene;

1,1,3-trifluoropropene; 1,2,3-trifluoropropene; 1,3,3-trifluoropropene; 2,3,3-trifluoropropene; 3,3,3-trifluoropropene; 1-fluoro-1-butene; 2-fluoro-1-butene; 3-fluoro-1-butene; 4-fluoro-1-butene; 1,1-difluoro-1-butene; 1,2-difluoro-1-butene; 1,3-difluoropropene; 1,4-difluoro-1-butene; 2,3-difluoro-1-butene; 2,4-difluoro-1-butene; 3,3-difluoro-1-butene; 3,4-difluoro-1-butene; 4,4-difluoro-1-butene; 1,1,2-trifluoro-1-butene; 1,1,3-trifluoro-1-butene; 1,1,4-trifluoro-1-butene; 1,2,3-trifluoro-1-butene; 1,2,4-trifluoro-1-butene; 1,3,3-trifluoro-1-butene; 1,3,4-trifluoro-1-butene; 1,4,4-trifluoro-1-butene; 2,3,3-trifluoro-1-butene; 2,3,4-trifluoro-1-butene; 2,4,4-trifluoro-1-butene; 3,3,4-trifluoro-1-butene; 3,4,4-trifluoro-1-butene; 4,4,4-trifluoro-1-butene; 1,1,2,3-tetrafluoro-1-butene; 1,1,2,4-tetrafluoro-1-butene; 1,1,3,3-tetrafluoro-1-butene; 1,1,3,4-tetrafluoro-1-butene; 1,1,4,4-tetrafluoro-1-butene; 1,2,3,3-tetrafluoro-1-butene; 1,2,3,4-tetrafluoro-1-butene; 1,2,4,4-tetrafluoro-1-butene; 1,3,3,4-tetrafluoro-1-butene; 1,3,4,4-tetrafluoro-1-butene; 1,4,4,4-tetrafluoro-1-butene; 2,3,3,4-tetrafluoro-1-butene; 2,3,4,4-tetrafluoro-1-butene; 2,4,4,4-tetrafluoro-1-butene; 3,3,4,4-tetrafluoro-1-butene; 3,4,4,4-tetrafluoro-1-butene; 1,1,2,3,3-pentafluoro-1-butene; 1,1,2,3,4-pentafluoro-1-butene; 1,1,2,4,4-pentafluoro-1-butene; 1,1,3,3,4-pentafluoro-1-butene; 1,1,3,4,4-pentafluoro-1-butene; 1,1,4,4,4-pentafluoro-1-butene; 1,2,3,3,4-pentafluoro-1-butene; 1,2,3,4,4-pentafluoro-1-butene; 1,2,4,4,4-pentafluoro-1-butene; 2,3,3,4,4-pentafluoro-1-butene; 2,3,4,4,4-pentafluoro-1-butene; 3,3,4,4,4-pentafluoro-1-butene; 1,1,2,3,3,4-hexafluoro-1-butene; 1,1,2,3,4,4-hexafluoro-1-butene; 1,1,2,4,4,4-hexafluoro-1-butene; 1,2,3,3,4,4-hexafluoro-1-butene; 2,3,3,4,4,4-hexafluoro-1-butene; 1,1,2,3,3,4,4-heptafluoro-1-butene; 1,1,2,3,4,4,4-heptafluoro-1-butene; 1,1,3,3,4,4,4-heptafluoro-1-butene; 1,2,3,3,4,4,4-heptafluoro-1-butene; 1-fluoro-2-butene; 2-fluoro-2-butene; 1,1-difluoro-2-butene; 1,2-difluoro-2-butene; 1,3-difluoro-2-butene; 1,4-difluoro-2-butene; 2,3-difluoro-2-butene; 1,1,1-trifluoro-2-butene; 1,1,2-trifluoro-2-butene; 1,1,3-trifluoro-2-butene; 1,1,4-trifluoro-2-butene; 1,2,3-trifluoro-2-butene; 1,2,4-trifluoro-2-butene; 1,1,1,2-tetrafluoro-2-butene; 1,1,1,3-tetrafluoro-2-butene; 1,1,1,4-tetrafluoro-2-butene; 1,1,2,3-tetrafluoro-2-butene; 1,1,2,4-tetrafluoro-2-butene; 1,2,3,4-tetrafluoro-2-butene; 1,1,1,2,3-pentafluoro-2-butene; 1,1,1,2,4-pentafluoro-2-butene; 1,1,1,3,4-pentafluoro-2-butene; 1,1,1,4,4-pentafluoro-2-butene; 1,1,2,3,4-pentafluoro-2-butene; 1,1,2,4,4-pentafluoro-2-butene; 1,1,1,2,3,4-hexafluoro-2-butene; 1,1,1,2,4,4-hexafluoro-2-butene; 1,1,1,3,4,4-hexafluoro-2-

butene; 1,1,1,4,4,4-hexafluoro-2-butene; 1,1,2,3,4,4-hexafluoro-2-butene; 1,1,1,2,3,4,4-heptafluoro-2-butene; 1,1,1,2,4,4,4-heptafluoro-2-butene; and mixtures thereof.

23. (cancelled)

24. (previously presented) The copolymer of claim 12, wherein the diluent comprises from 15 to 100 volume % HFC based upon the total volume of the diluent.

25. – 26. (cancelled)

27. (previously presented) The copolymer of claim 12, wherein the diluent further comprises a hydrocarbon, a non-reactive olefin, and/or an inert gas.

28. (previously presented) The copolymer of claim 12, wherein the diluent further comprises a halogenated hydrocarbon other than an HFC.

29. (cancelled)

30. (previously presented) The copolymer of claim 12, wherein the one or more Lewis acid(s) is represented by a formula selected from the group consisting of

a)  $MX_4$

wherein M is a Group 4, 5, or 14 metal; and  
each X is a halogen;

b)  $MR_nX_{4-n}$

wherein M is Group 4, 5, or 14 metal;  
each R is a monovalent  $C_1$  to  $C_{12}$  hydrocarbon radical independently selected from the group consisting of an alkyl, aryl, arylalkyl, alkylaryl and cycloalkyl radicals;

$n$  is an integer from 0 to 4; and

each X is a halogen;

c)  $M(RO)_nR'_mX_{4-(m+n)}$

wherein M is Group 4, 5, or 14 metal;

each RO is a monovalent C<sub>1</sub> to C<sub>30</sub> hydrocarboxy radical independently selected from the group consisting of an alkoxy, aryloxy, arylalkoxy, alkylaryloxy radicals;

each R' is a monovalent C<sub>1</sub> to C<sub>12</sub> hydrocarbon radical independently selected from the group consisting of an alkyl, aryl, arylalkyl, alkylaryl and cycloalkyl radicals;

*n* is an integer from 0 to 4;

*m* is an integer from 0 to 4, wherein the sum of *n* and *m* is not more than 4; and

each X is a halogen; and

d) M(RC=OO)<sub>*n*</sub>R'<sub>*m*</sub>X<sub>4-(*m*+*n*)</sub>

wherein M is Group 4, 5, or 14 metal;

each RC=OO is a monovalent C<sub>2</sub> to C<sub>30</sub> hydrocarbacyl radical independently selected from the group consisting of an alkacyloxy, arylacyloxy, arylalkylacyloxy, alkylarylacyloxy radicals;

each R' is a monovalent C<sub>1</sub> to C<sub>12</sub> hydrocarbon radical independently selected from the group consisting of an alkyl, aryl, arylalkyl, alkylaryl and cycloalkyl radicals;

*n* is an integer from 0 to 4;

*m* is an integer from 0 to 4, wherein the sum of *n* and *m* is not more than 4; and

each X is a halogen.

31. - 33 (cancelled)

34. (previously presented) The copolymer of claim 12, wherein the one or more Lewis acid(s) is represented by a formula selected from the group consisting of:

a) MOX<sub>3</sub>

wherein M is a Group 5 metal; and

each X is a halogen;

b) MX<sub>3</sub>;

wherein M is a Group 13 metal; and

each X is a halogen;

c) MR<sub>*n*</sub>X<sub>3-*n*</sub>

wherein M is a Group 13 metal;

each R is a monovalent C<sub>1</sub> to C<sub>12</sub> hydrocarbon radical independently selected from the group consisting of an alkyl, aryl, arylalkyl, alkylaryl and cycloalkyl radicals;

*n* is an integer from 1 to 3; and

each X is a halogen;

d)  $M(RO)_nR'_mX_{3-(m+n)}$

wherein M is a Group 13 metal;

each RO is a monovalent C<sub>1</sub> to C<sub>30</sub> hydrocarboxy radical independently selected from the group consisting of an alkoxy, aryloxy, arylalkoxy, alkylaryloxy radicals;

each R' is a monovalent C<sub>1</sub> to C<sub>12</sub> hydrocarbon radical independently selected from the group consisting of an alkyl, aryl, arylalkyl, alkylaryl and cycloalkyl radicals;

n is an integer from 0 to 3;

m is an integer from 0 to 3, wherein the sum of n and m is from 1 to 3; and

each X is a halogen; and

e)  $M(RC=OO)_nR'_mX_{3-(m+n)}$ ;

wherein M is a Group 13 metal;

each RC=OO is a monovalent hydrocarbacyl radical independently selected from the group independently selected from the C<sub>2</sub> to C<sub>30</sub> group consisting of an alkacyloxy, arylacyloxy, arylalkylacyloxy, alkylarylacyloxy radicals;

each R' is a monovalent C<sub>1</sub> to C<sub>12</sub> hydrocarbon radical independently selected from the group consisting of an alkyl, aryl, arylalkyl, alkylaryl and cycloalkyl radicals;

n is an integer from 0 to 3;

m is an integer from 0 to 3, wherein the sum of n and m is from 1 to 3; and

each X is a halogen.

35. – 38. (cancelled)

39. (previously presented) The copolymer of claim 12, wherein the one or more Lewis acid(s) is represented by a formula selected from the group consisting of:

a)  $MX_y$

wherein M is a Group 15 metal;

each X is a halogen; and

y is 3, 4 or 5;

b)  $MR_nX_{y-n}$ ;

wherein M is a Group 15 metal;

each R is a monovalent C<sub>1</sub> to C<sub>12</sub> hydrocarbon radical independently selected from the group consisting of an alkyl, aryl, arylalkyl, alkylaryl and cycloalkyl radicals;

$n$  is an integer from 0 to 4;  
 $y$  is 3, 4 or 5, wherein  $n$  is less than  $y$ ; and  
each  $X$  is a halogen;

c)  $M(RO)_nR'_mX_{y-(m+n)}$ ;

wherein  $M$  is a Group 15 metal,  
each  $RO$  is a monovalent  $C_1$  to  $C_{30}$  hydrocarboxy radical independently selected from the group consisting of an alkoxy, aryloxy, arylalkoxy, alkylaryloxy radicals;  
each  $R'$  is a monovalent  $C_1$  to  $C_{12}$  hydrocarbon radical independently selected from the group consisting of an alkyl, aryl, arylalkyl, alkylaryl and cycloalkyl radicals;  
 $n$  is an integer from 0 to 4;  
 $m$  is an integer from 0 to 4;  
 $y$  is 3, 4 or 5, wherein the sum of  $n$  and  $m$  is less than  $y$ ; and  
each  $X$  is a halogen; and

d)  $M(RC=OO)_nR'_mX_{y-(m+n)}$ ;

wherein  $M$  is a Group 15 metal;  
each  $RC=OO$  is a monovalent  $C_2$  to  $C_{30}$  hydrocarbacyloxy radical independently selected from the group consisting of an alkacyloxy, arylacyloxy, arylalkylacyloxy, alkylarylacyloxy radicals;  
each  $R'$  is a monovalent  $C_1$  to  $C_{12}$  hydrocarbon radical independently selected from the group consisting of an alkyl, aryl, arylalkyl, alkylaryl and cycloalkyl radicals;  
 $n$  is an integer from 0 to 4;  
 $m$  is an integer from 0 to 4;  
 $y$  is 3, 4 or 5, wherein the sum of  $n$  and  $m$  is less than  $y$ ; and  
each  $X$  is a halogen.

40. – 45. (cancelled)

46. (previously presented) The copolymer of claim 12, wherein the one or more initiator(s) comprise a hydrogen halide, a carboxylic acid, a carboxylic acid halide, a sulfonic acid, an alcohol, a phenol, a polymeric halide, a tertiary alkyl halide, a tertiary aralkyl halide, a tertiary alkyl ester, a tertiary aralkyl ester, a tertiary alkyl ether, a tertiary aralkyl ether, an alkyl halide, an aryl halide, an alkylaryl halide or an arylalkylacid halide.



47. – 49. (cancelled)
50. (previously presented) The copolymer of claim 12, wherein the one or more initiator(s) further comprise a weakly-coordinating anion.
51. (previously presented) The copolymer of claim 12, wherein the one or more initiator(s) comprise greater than 30 ppm water (based upon weight).
52. (previously presented) The copolymer of claim 12, wherein the contacting further comprises contacting one or more monomer(s) independently selected from the group consisting of olefins, alpha-olefins, disubstituted olefins, isoolefins, conjugated dienes, non-conjugated dienes, styrenics, substituted styrenics, and vinyl ethers.
53. (cancelled)
54. (previously presented) The copolymer of claim 7, wherein the copolymer is halogenated to form a halogenated copolymer.
55. – 57. (cancelled)
58. (previously presented) The copolymer of claim 7, wherein the copolymer has a Mw of greater than 10,000.
59. - 61. (cancelled)
62. (currently amended) The copolymer of claim 7, wherein the copolymer has a MWD from about 2 to about 5.
63. – 69. (cancelled)
70. (Original) A blend comprising the copolymer of claim 7 and a secondary rubber independently from the group consisting of at least one of natural rubber,

polyisoprene rubber, poly(styrene-*co*-butadiene) rubber (SBR), polybutadiene rubber (BR), poly(isoprene-*co*-butadiene) rubber (IBR), styrene-isoprene-butadiene rubber (SIBR), ethylene-propylene rubber (EPR), ethylene-propylene-diene rubber (EPDM), polysulfide, isobutylene/cyclopentadiene copolymer rubber, isobutylene/methyl cyclopentadiene copolymer rubber, nitrile rubber, propylene oxide polymers, star-branched butyl rubber and halogenated star-branched butyl rubber, brominated butyl rubber, chlorinated butyl rubber, star-branched polyisobutylene rubber, star-branched brominated butyl (polyisobutylene/isoprene copolymer) rubber; poly(isobutylene-*co*-*p*-methylstyrene) and halogenated poly(isobutylene-*co*-*p*-methylstyrene), halogenated poly(isobutylene-*co*-isoprene-*co*-*p*-methylstyrene), poly(isobutylene-*co*-isoprene-*co*-styrene), halogenated poly(isobutylene-*co*-isoprene-*co*-styrene), poly(isobutylene-*co*-isoprene-*co*- $\alpha$ -methylstyrene) halogenated poly(isobutylene-*co*-isoprene-*co*- $\alpha$ -methylstyrene), and mixtures thereof.

- 71 (previously presented) The copolymer of claim 7, wherein the copolymer has a  $g'_{\text{vis.avg.}}$  from greater than or equal to 0.980 as determined by triple detection SEC.